

Inpatient Hyperglycemia - Adult

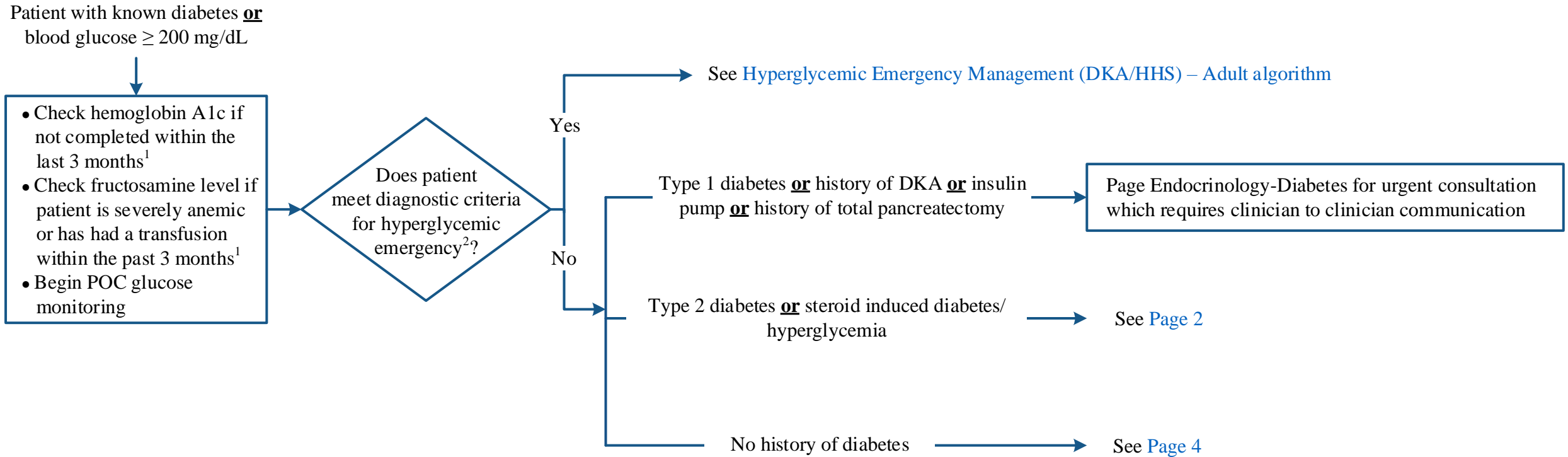
Disclaimer: *This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson's specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.*

Note: Insulin dose adjustments should be made based on the individual patient's glucoses. Refer to the [Hypoglycemia Management algorithm](#), as indicated.

PRESENTATION

INITIAL EVALUATION

TREATMENT



DKA = diabetic ketoacidosis
 HHS = hyperosmolar hyperglycemic state
 POC = point of care

¹ A1c may be inaccurate if recent blood transfusion within the past three months or severe anemia. Consider fructosamine level for patients with recent blood transfusion or severe anemia and who have normal renal and hepatic function.

² Diagnostic criteria:

DKA: blood glucose > 250 mg/dL and arterial pH < 7.3 **or** bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia

[**Note:** Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., empagliflozin, canagliflozin, ertugliflozin and dapagliflozin)]

HHS: blood glucose > 600 mg/dL and arterial pH > 7.3 **or** bicarbonate > 15 mEq/L, and minimal ketonuria and ketonemia

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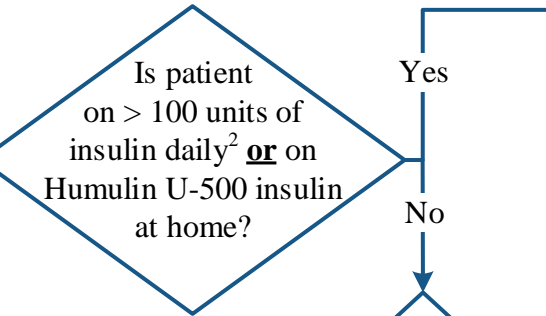
Note: Insulin dose adjustments should be made based on the individual patient's glucoses. Refer to the [Hypoglycemia Management algorithm](#), as indicated.

PRESENTATION

Type 2 diabetes or steroid induced diabetes/hyperglycemia

- Stop high-risk home medications¹
- Hold metformin if eGFR < 45 mL/minute/1.73 m²

ASSESSMENT

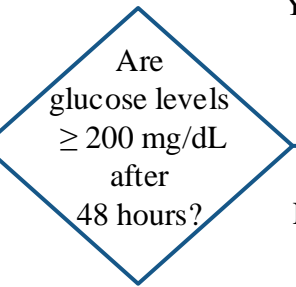


TREATMENT

Consult Endocrinology-Diabetes

See Page 3

- Initiate basal bolus insulin therapy at 0.4 units/kg/day subcutaneous with 50% of TDD used for prandial fixed bolus (lispro) dosing and 50% used for basal (glargine) dosing (see [Appendix A and B](#))
- Assess insulin needs every 24 hours
- Consider a no concentrated carbohydrate diet



Consult Endocrinology-Diabetes

- Discharge planning:
- Consider resuming home medications, as appropriate
 - For patients with hemoglobin A1c < 7.5%⁴:
 - Follow up with primary care provider
 - For patients with hemoglobin A1c 7.5-9%⁴:
 - Consult Diabetes Educator
 - Follow up with primary care provider or General Internal Medicine
 - For patients with hemoglobin A1c > 9%⁴:
 - Consult Diabetes Educator
 - Arrange ambulatory referral to Endocrinology-Diabetes

eGFR = estimated glomerular filtration rate
 NPH = neutral protamine Hagedorn
 TDD = total daily dose
 TPN = total parenteral nutrition

¹ Hold home insulin and oral hypoglycemic agents such as sulfonylureas (glipizide, glyburide, glimepiride, gliclazide), meglitinides (rapaglinide, nateglinide) and SGLT-2 inhibitors (canagliflozin, dapagliflozin, empagliflozin, ertugliflozin). Generally, metformin and DPP-4 inhibitors (sitagliptin, linagliptin, saxagliptin) are safe to continue if renal and liver function are stable.

² Calculation of total daily insulin taken at home: add the total units of all long acting (glargine, degludec, or detemir), intermediate acting (NPH), and short acting (lispro, aspart, glulisine, or regular) insulin in a typical 24 hour period

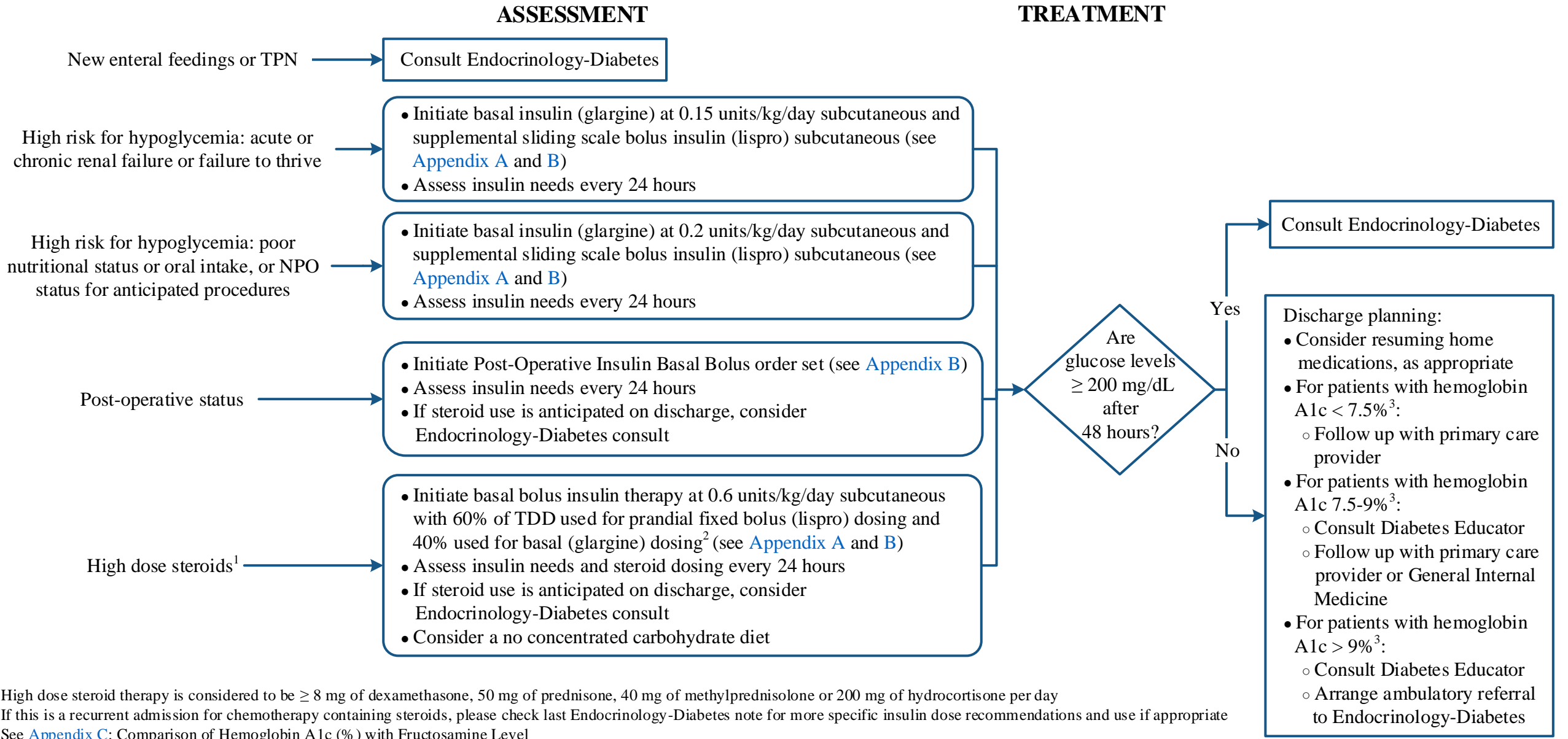
³ Risk factors for hyperglycemia include: • New enteral feedings or TPN • Post-operative status • High dose steroids (see [Page 3](#))

Risk factors for hypoglycemia include: • Acute or chronic renal failure • Poor nutritional status or oral intake • Failure to thrive • NPO status for anticipated procedures

⁴ See [Appendix C](#): Comparison of Hemoglobin A1c (%) with Fructosamine Level

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Note: Insulin dose adjustments should be made based on the individual patient's glucoses. Refer to the [Hypoglycemia Management algorithm](#), as indicated.



¹ High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day

² If this is a recurrent admission for chemotherapy containing steroids, please check last Endocrinology-Diabetes note for more specific insulin dose recommendations and use if appropriate

³ See [Appendix C](#): Comparison of Hemoglobin A1c (%) with Fructosamine Level

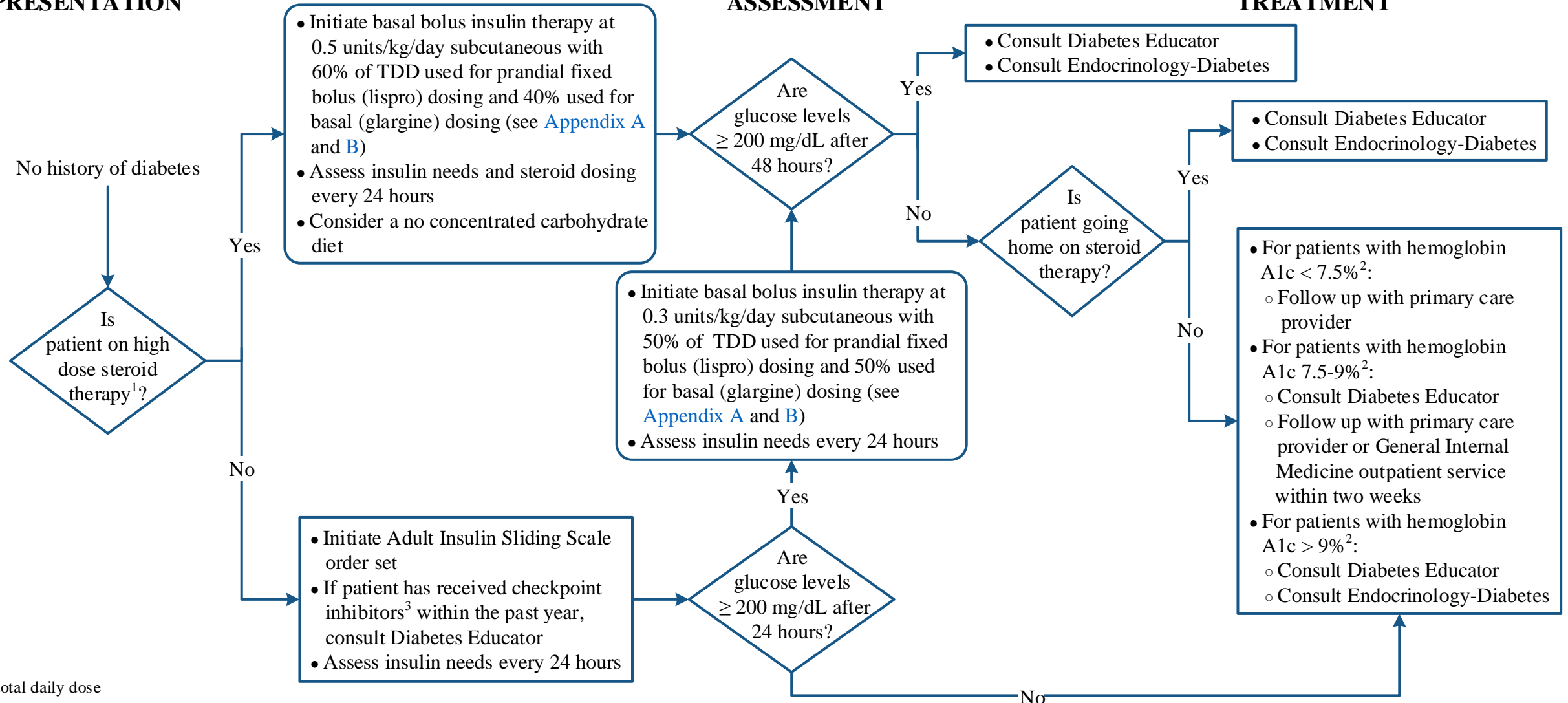
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PRESENTATION

ASSESSMENT

TREATMENT



TDD = total daily dose

¹ High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day

² See [Appendix C](#): Comparison of Hemoglobin A1c (%) with Fructosamine Level

³ Checkpoint inhibitors: nivolumab, pembrolizumab, durvalumab, atezolizumab, and related drugs. Patients with recent exposure to checkpoint inhibitors are at risk for DKA and should be evaluated for possible new onset type 1 diabetes mellitus.

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APPENDIX A: Common Insulin Types and Frequency

Fast Acting Insulin	Dose Frequency
Lispro (Humalog [®])	Before meals or every 4 hours
Aspart (Novolog [®]) ¹	Before meals or every 4 hours
Regular insulin (Novolin [®] -R/Humulin [®] -R)	Before meals or every 6 hours
Long Acting Insulin	
Glargine (Lantus [®] /Basaglar [®] /Toujeo [®])	Daily or every 12 hours
Determir (Levemir [®])	Daily or every 12 hours
Degludec (Tresiba [®]) ¹	Daily
Intermediate Acting Insulin	
NPH (Novolin [®] -N/Humulin [®] -N)	Every 12 hours
Mixed Insulin	
70/30, 75/25 ¹ , 50/50 ¹ (mixes of NPH and a fast acting insulin)	Every 12 hours or every 6 hours with continuous tube feedings

¹ Not currently on MD Anderson Formulary

APPENDIX B: Basal Bolus Insulin Terms

- **Bolus** insulin refers to a dose of fast acting insulin. This is typically comprised of **prandial** insulin which is scheduled to compensate for the carbohydrate content of a meal and **supplemental** (or sliding scale) insulin to correct hyperglycemia. Bolus insulin is most effective when given before meals, but supplemental insulin alone can be scheduled for patients who are not eating or are high risk for hypoglycemia.
- **Basal** insulin refers to a dose of long acting insulin given 1 or 2 times daily. These insulins absorb slowly to help maintain stable glucose levels.
- **Supplemental** insulin is dosed based on either weight or total daily insulin requirement
- A **basal/bolus** insulin regimen uses both types of insulin to recreate a physiologic pattern of insulin release. This regimen is more effective for most patients than sliding scale supplemental insulin only. Most patients need about half of their insulin as basal and half as bolus. Patients on high doses of steroids will often need more bolus insulin.

APPENDIX C: Comparison of Hemoglobin A1c (%) with Fructosamine Level

Hemoglobin A1c (%)	Fructosamine Level (µmol)
7	287.5
7.5	306.25
8	325
9	362.5

Note: Each 2% change in hemoglobin A1c represents an approximate 75 µmol change in fructosamine

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SUGGESTED READINGS

- Guillausseau, P., Charles, M., Godard, V., Timsit, J., Chanson, P., Paolaggi, F., . . . Guillausseau, P. (1990). Comparison of fructosamine with glycated hemoglobin as an index of glycemic control in diabetic patients. *Diabetes Research*, 13(3), 127–131. Retrieved from <http://search.proquest.com/docview/80331793/>
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